4. WASTE ACCEPTANCE, STORAGE AND TRANSPORTATION

4.1 SCOPE

DOE will rely on the private sector to provide the necessary services and equipment required to accept and transport commercial SNF to the repository. These services and equipment will be procured by awarding one or more contracts, with each contract covering Purchasers' sites in certain designated regions in the contiguous United States. Purchasers are those owners of commercial SNF who have entered into contracts with DOE for disposal of their SNF. Each CRWMS regional servicing contractor (RSC) will be responsible for all activities and services in its region, including the provision of transportation cask/canister systems and ancillary equipment to accept commercial SNF and transport it to the repository for disposal. Specific performance requirements for each RSC will be set forth in detail in the procurement documents.

Transportation will be carried out using commercially available equipment and approved routes in compliance with NRC and Department of Transportation regulations. To the extent practicable, DOE will rely on the private sector to provide the necessary services and equipment to accept and transport HLW and DOE SNF (except naval SNF) to the repository. The U.S. Navy will provide transportation of its SNF to the repository.

The waste acceptance and transportation elements of the CRWMS will accept commercial SNF, including MOX fuel, from commercial reactors; DOE SNF and HLW from DOE sites; and HLW and SNF from West Valley; and will transport the materials to the repository. The operational waste acceptance element provides the interface between the CRWMS, the utilities, and DOE sites to maintain contracts and agreements, verify records, verify loading and accept the waste, and maintain material control and accounting. The operational transportation element is responsible for the shipment of SNF and HLW to the repository. Transportation costs do not include the cost for shipping naval SNF to the repository. However, costs for decommissioning the transportation casks at the end of operations are included. Under the current plan, commercial reactors will store commercial SNF on site until acceptance and transport to the repository.

The Waste Acceptance cost category includes the following activities: 1) development of a process for the orderly transfer of SNF and HLW into the Federal system consistent with the needs of both the Federal Government and the owners and generators; 2) development and maintenance of a plan to carry out the Program's waste acceptance responsibilities; 3) development of a collaborative dialogue with the Nation's nuclear utility companies as well as other owners and interested stakeholders; 4) verification of the fees collected for commercial SNF; 5) maintenance and implementation of the provisions in the Standard Contract (10 CFR 961); and 6) provision of contingency planning support, studies, and analyses directed toward the competitive private sector transportation strategy.

4.2 ASSUMPTIONS

As a basis for planning, OCRWM uses the no-new-orders, end of reactor life case, referenced in the *WAST-Cost Estimate Assumptions Document* (CRWMS M&O 1998b). For commercial SNF, this case does not assume additional early reactor shutdowns or service life extensions that

would reduce or increase projected quantities of SNF, respectively. Commercial SNF, DOE SNF, and HLW pickup is assumed to begin in 2010. Initial acceptance rates for DOE SNF and HLW are assumed to be low until 2015. Commercial fuel pickup assumes that the youngest fuel greater than or equal to 10 years old is picked up from the sites first. Allocation rights for commercial SNF will be assigned to Purchasers using the oldest fuel first, in accordance with the *Acceptance Priority Ranking and Annual Capacity Report (APR/ACR)* (DOE 1995a) and agreements with the utilities. Table 11 shows the acceptance rate for commercial SNF by MTHM per year. Decommissioning activities are assumed to begin at the conclusion of shipping activities and continue for a year.

Table 11. Acceptance Rates of Commercial Spent Nuclear Fuel

Year	Acceptance Rate (MTHM/year)
1999 – 2009	0
2010	400[a]
2011	600
2012	1,200
2013	2,000
2014	3,000
2015 – 2040	3,000
2041	1,117
Total	**86,317**

[a]Since acceptance starts March 31, 2010, an acceptance rate of 400 MTHM/year results in approximately 200 MTHM in FY 2010.

All commercial SNF is stored at utility sites prior to being transported to the MGR. Neither storage nor "take title" costs at utility sites are included in this TSLCC analysis. The cost of MOX SNF transportation casks and transportation from utility sites to the MGR is included in this TSLCC analysis as part of the commercial allocation. MOX SNF is assumed to be transported in a commercial 21-PWR uncanistered fuel cask containing only 9 assemblies.

It is assumed that DOE SNF will arrive in disposable canisters. The canisters will contain various quantities of fuel assemblies depending on fuel types and characteristics. Transportation casks for DOE SNF are assumed to contain from one to six disposable canisters per cask, depending on fuel type.

The quantity of DOE SNF (Table 12) was based on a DOE-furnished integrated database (CRWMS M&O 1998a), and was used in the development of transportation-related costs. Transportation costs of DOE materials are included in the TSLCC analysis, with the assumption that transportation is to be via round trip one-car rail general freight. Development and procurement of transportation casks for DOE SNF are not part of the CRWMS as these casks will be designed and purchased by the DOE without funds from OCRWM. Therefore, these costs are excluded from the TSLCC estimate. Prior to acceptance into the transportation system, DOE SNF is placed in canisters at the DOE facilities managing the nuclear material. The costs for transportation of naval SNF are not included in the TSLCC. The U.S. Navy will provide transportation of naval SNF to the MGR.

Table 12. Acceptance Rates of DOE Spent Nuclear Fuel

Year	Acceptance (Canisters)	Year	Acceptance (Canisters)
2010	1	2023	141
2011	1	2024	161
2012	3	2025	232
2013	6	2026	237
2014	8	2027	229
2015	109	2028	236
2016	150	2029	253
2017	116	2030	250
2018	206	2031	253
2019	172	2032	248
2020	200	2033	138
2021	204	2034	100
2022	144	2035	59
Total			**3,857**

HLW (Table 13) is based on projections of vitrified tank wastes from Hanford, Savannah River Site (SRS), Idaho National Engineering and Environmental Laboratory (INEEL), and West Valley (WV) Demonstration Project (CRWMS M&O 1998a). All HLW is transported to the repository in rail transportation casks, which will be certified by the NRC. HLW rail transportation costs are based on round-trip general freight shipping charges. Costs for vitrification of HLW, by WV and DOE facilities that manage these tasks, are not included in this estimate. The costs for transportation cask design, acquisition, and transport of HLW from the DOE producer sites to the MGR are included in the total program costs. Defense HLW includes 18 metric tons of IPWF, which equals approximately 635 HLW canisters containing plutonium that are back-filled with vitrified HLW.

Table 13. Acceptance Rates of High-Level Waste

Year	Acceptance Rate (Canisters)
2010 - 2014	150
2015	355
2016	376
2017 - 2018	430
2019	420
2020 - 2025	395
2026 - 2028	375
2029 - 2031	455
2032	450
2033	255
2034 - 2035	1,475
2036	1,471
2037 - 2040	1,450
2041	1,457
Total	**20,004**

This analysis assumes that 18 transportation cask designs are required. Specifically, the assumed cask designs include two for commercial legal-weight truck (LWT) transportation, nine for commercial SNF rail, five for DOE SNF rail transportation, and two for HLW rail transportation. Cask design assumptions are based on the fuel type, whether for a PWR or a BWR, size, and thermal properties of all fuel assemblies expected to be transported to the repository for disposal. Costs for acquisition, maintenance, refurbishment, and decommissioning of transportation casks are included, with the exception of DOE casks. The costs for DOE transportation cask acquisition and maintenance are not part of the CRWMS. Contingencies on cask cost estimates are assumed to be sufficient to procure any specialty casks required to accommodate assemblies that cannot be accommodated by 1 of the 18 designs.

Table 14 provides an estimate of the size of the required transportation cask fleet. This cost estimate assumes a competitive private sector approach for the transportation of waste to the repository. This approach assumes DOE contracts for commercial SNF transportation with four separate RSCs, who acquire a cask fleet and provide shipping for their region. This estimate does not assume any sharing of transportation assets between regions. In addition, a separate RSC will transport all HLW and DOE SNF. Actual cask fleet size will be determined upon contracting with RSCs. The cost estimate assumes all rail shipments to the repository are via one-car general freight.

Table 14. Transportation Cask Fleet

Cask Type	Quantity
Commercial Legal-Weight Truck	
BWR – 9 assembly capacity	5
PWR – 4 assembly capacity	8
Commercial Rail	
Large – PWR 24 or 26 assembly capacity Large – BWR 56 or 68 capacity	39
Medium – PWR 21 assembly capacity Medium – BWR 44 assembly capacity	22
Small – PWR 12 assembly capacity Small – BWR 32 assembly capacity	15
High Heat – PWR 12 assembly capacity High Heat – BWR 32 assembly capacity	7
South Texas – 17 assembly capacity	3
Yankee Rowe – 36 assembly capacity	1
Big Rock Point – 64 assembly capacity	1
West Valley – PWR 20 assembly capacity	1
West Valley – BWR 44 assembly capacity	1
HLW Rail	
Long (five 15-foot canisters)	14
Short (five 10-foot canisters)	8
DOE SNF Rail	
4 canister capacity	3
3 canister capacity	4
6 canister capacity	2
5 canister capacity	1
1 canister capacity	1

4.3 COST

The CALVIN model (CRWMS M&O 1999e) was used to calculate transportation costs. Transportation costs do not include the cost for shipping naval SNF. Under the current plan, commercial reactors will store commercial SNF on site until acceptance and transport to the repository. Table 15 summarizes all waste acceptance and transportation costs, including Nevada rail construction and operation costs.

Table 15. Summary of Waste Acceptance, Storage and Transportation Costs by Phase (in Millions of 1999$)

Phase	Historical (1983-1999)	Future Costs (2000-2042)
Development & Evaluation (1983-2005)	490	36
Mobilization, Acquisition, and Construction (2005-2010)	0	820
Waste Acceptance and Transportation Mobilization and Acquisition	0	110
Nevada Transportation Engineering and Construction	0	710
Operations & Acquisition (2010-2042)	0	5,070
Waste Acceptance and Transportation Operations and Acquisition	0	4,990
Nevada Transportation Operations	0	80
Total	**490**	**5,930**

NOTE: Historical costs total $0.4 Billion in YOE dollars; 1999 historical costs are an estimate.

4.3.1 Waste Acceptance, Storage and Transportation D&E

The D&E phase for the waste acceptance and transportation elements began with program inception and will continue until the acquisition of transportation equipment begins in 2005. D&E activities include planning technical assistance for training pursuant to the NWPA, Section 180(c) (DOE 1995b), establishing contracts with RSCs, establishing waste form criteria for DOE wastes, systems engineering, technology demonstration, quality assurance, and environmental safety and health activities. Costs for the storage and multi-purpose canister (MPC) elements were for activities that have been canceled or suspended, and additional costs are not expected in the future. Table 16 provides costs for D&E activities.

Table 16. Waste Acceptance, Storage and Transportation Design and Evaluation Costs (in Millions of 1999$)

Cost Element	Historical (1983-1999)	Future Costs (2000-2005)
Storage	210	0
National Transportation	210	22
Waste Acceptance	24	7
Multi-Purpose Canister Project	38	0
Project Management & Integration	9	7
Total	**490**	**36**

NOTE: Historical costs total $0.4 Billion in YOE dollars; 1999 historical costs are an estimate.

4.3.2 Waste Acceptance and Transportation Mobilization and Acquisition

The WAST Project mobilization and acquisition phase begins in 2005, and continues until acceptance operations begin in 2010. After contracts are awarded for mobilization and acquisition, the RSCs will perform waste acceptance and transportation activities. The activities include establishing agreements with each site regarding schedule, procuring and licensing of transportation hardware, and contracting for rail and truck shipments of SNF to the repository. Table 17 shows the costs for the mobilization and acquisition phase.

Table 17. Waste Acceptance and Transportation Mobilization and Acquisition Costs (in Millions of 1999$)

Cost Element	Future Costs (2005 - 2010)
National Transportation	91
Waste Acceptance	10
Project Management & Integration	10
Total	**110**

4.3.3 Waste Acceptance and National Transportation Operations

The operations phase begins in 2010, when acceptance and transportation of SNF and HLW from sites to the repository starts. The operations phase concludes in 2042 when all SNF and HLW have been transported to the repository, and the transportation casks have been decommissioned. During this phase, continuing acquisition of transportation hardware occurs to handle increases in throughput and transportation equipment replacement. Table 18 shows the costs for waste acceptance and national transportation during the operations phase.

Table 18. Waste Acceptance and Transportation Acceptance Operation Costs (in Millions of 1999$)

Cost Element	Future Costs (2010 - 2042)
National Transportation	4,930
Waste Acceptance	57
Total	**4,990**

The cost basis for railroad shipping rates for nuclear waste is unchanged from the 1998 TSLCC estimate (DOE 1998a). There is historical precedence that indicates that lower costs may be achievable; however, there is uncertainty regarding the ultimate shipping rates that will be effective when shipment of SNF and HLW occurs on an ongoing basis.

4.3.4 Nevada Transportation

The Nevada transportation engineering and construction phase begins in 2002 and concludes in 2010 with the start of emplacement operations. Activities include the design and construction of a branch rail line in Nevada to the repository site. Since no specific rail routing has been

determined, the estimated cost is the average cost of five studied route options. An overall contingency of 60 percent was included to allow for cost estimating uncertainty (15 to 25 percent) and route uncertainty. Nevada rail transportation operations begin in 2010, and continue until the end of emplacement in 2042 including an additional year for decommissioning activities. Table 19 shows the Nevada transportation costs.

Table 19. Nevada Transportation Costs (in Millions of 1999$)

Cost Element	Future Costs (2002-2042)
Engineering & Construction (2002-2010)	710
Emplacement Operations (2010-2042)	80
Total	**790**